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On the Cordaites and their related generic divisions, in the Carboniferous formation of the United States.

BY L. LESQUEREUX.

(Read before the American Philosophical Society, March 1, 1878.)

NÆGGERATHIÆ.

This family of plants was established by Brongniart on a species of Sternberg, *Næggerathia foliosa*, described in Flora der Vorwelt, II, p. 28, Pl. XX, already in 1852. The species is represented by a slender stem or rachis, bearing obovate, alternate pinnules, attached to the rachis by a narrowed base, with simple, straight, dichotomous nerves, slightly projecting at the borders. This plant whose relation was not recognized by Sternberg has not been found since. Gœppert, who received specimens from Sternberg, described and figured it again in his Gattungen, and considered it as a fern related to *Ocylopteris*. Brongniart, however, comparing it to species of *Zamia*, he placed it between the *Cicadæ* and the *Conifers*, a place which seems legitimate. The large number of species described since as *Næggerathia* are all of uncertain affinity, and apparently referable to the following generic division, that of the *Cordaites*; at least, I admit them into it. The leaves of *Næggerathia* are two sided, those of the *Cordaites* are in spiral order; we have none of the first.

Brongniart in his Tableau des Genres, 1849, established, under the name *Pychnophyllum*, a second genus of the same family from another of Sternberg's species, *Flabellaria borassifolia*; while about at the same time Unger described it as *Cordaites borassifolius*, 1850. Sternberg had referred his plant to the Palms, but Corda, who in 1845, admirably defined its characters by microscopical analysis of its structure in his Beiträge, p. 44, Pl. XXIV and XXV, separated it from the Palms, and found its affinity to *Lomatoflois* and *Sigillaria*, comparing it to species of *Dracæna* of our time. The preservation of the name of *Cordaites*, in deference to the admirable work of Corda, is indeed legitimate, and has been until now generally preserved.

GROUP OF CORDAITES.

Perhaps no remains are more generally and abundantly found in the coal measures, from the Devonian to the Permian, than those of *Cordaites*. They are generally fragments of ribbon-like long leaves, most rarely found in connection with the stems; for since Sternberg whose specimens were used by Corda for his illustration of stems and leaves, I do not know that until recently any specimens of *Cordaites* have been found anywhere with leaves connected to a stem, except one figured here which I discovered years ago in the upper anthracite Salem vein, near Pottsville, Pennsylvania. Even single leaves of *Cordaites* are rarely found entire, or in their whole length. In some coal beds of Illinois layers of shale one foot thick, or more, are composed, so to say, of those leaves heaped and pressed one

upon another without any other kind of vegetable remains. There, also, I could never obtain a fragment of stem nor any kind of fruits which could be used for completing in some way the description of the characters of the genus.

Now from the specimens recently published in the splendid Coal Flora of Grand'Eury, and from those which are described and figured here, and which give, perhaps, still more evidence in regard to the relation of the *Cordaïtes*, the genus may be characterized as follows :

CORDAITES Ung.

Stems or branches with a large medular canal, marked outside by transverse narrow close ribs, sometimes joined by divisions, covered with double or triple layers of bark, recognized in the fossil state by two or more thin layers of coal, that of the surface being more or less distinctly marked by semi-lunar inflated scar of leaves, and bearing also, as seen from our specimens, oblique divisions or branchlets. The naked stems have been generally described under the name of *Artisia* or *Sternbergia*, when found deprived of the bark. Leaves in spiral order, more or less distant, sometimes imbricated, ribbon-like, of various lengths and width, mostly linear or gradually enlarging upwards, generally obtuse, sometimes undulate, and more or less deeply split at the top, curving to and somewhat inflated at the sessile or semi-embracing base, marked lengthwise with parallel primary and secondary nerves or lines more or less distinct, generally more distant in the middle of the leaves, and somewhat inflated toward the base. According to the enlarging progress of the leaves towards the point, the nerves divide by splitting, a division which is rarely observable.

The stems bear racemes of flowers, rarely found, however, going out of the axils of the leaves. Two kinds are figured here, seemingly bearing, one male, the other fertile flowers. They evidently represent, in part at least, the so-called *Antholites*, which until now have been separately considered without positive reference.

The fruits of *Cordaïtes* are described by Grand'Eury under the names of *Cordaicarpus*, *Diplotesta*, *Carpolithes Grand'Eurianus*, *C. avellanus*, and *C. Gutbieri*; none of which, except the two last species have been found in connection with the specimens published here, or in the same clayed cannel coal wherefrom they are derived. The more common species of fruits of this locality are figured here as future points of comparison.

No silicified remains of these plants have as yet been found in the American coal measures, and therefore, anatomical and microscopical researches in regard to their internal structure are here impossible. The only analysis made from a silicified stem, is that by Corda, loc. cit. European authors, especially Gœppert, Weiss and Grand'Eury, have discussed at length the characters of the *Cordaïtes* and their relation. This consideration, pursued from different points of view, though very instructive and interesting, cannot find place here.

We owe to the systematic researches of Mr. I. F. Mansfield, of Cannelton, the discovery of a large number of specimens of this genus which have

been mostly used for the figures and descriptions of the carboniferous flora. They supply a considerable amount of evidence on the relation of various forms which had been from fragments referred to different generic divisions or even to different families, and also on the peculiar mode of vegetation of these plants. Certainly the vegetable paleontology of our coal is greatly indebted to this ardent, careful and very experienced collector.

The American species of *Cordaites*, as far as we know them up to the present time, are referable to different divisions which I have merely named in the margin.

[CRASSIFOLLE.] *CORDAITES VALIDUS*, sp. nov.

*Pl. XLVII, fig. 1, 2.**

Leaves thick, very long, linear, as far as shown by the fragments, thirty-five centimeters long, half embracing the stem at the base, five to eight centimeters broad, slightly enlarged in turning to the inflated point of attachment whose scar is subcordate, narrowly, nearly equally and obscurely striate on the upper surface, where the veins, seven or eight per millimeter, are immersed into the epidermis; more distinctly marked on the lower surface where they are obtuse or keeled, irregular in distance, three to five per millimeter, sometimes with an intermediate secondary vein, more generally with an obtuse furrow between them.

The fragment of stem figured is more coarsely and irregularly striate than the leaves, the striæ being here and there inflated, thus irregular in size, so that at first sight or without glass, the nerves do not appear continuous. They are so, however, two, sometimes three in one millimeter, even one millimeter apart. The coaly layer of the bark is about one millimeter thick, sometimes more. The same thickness of coal takes the place of the leaves upon the lower somewhat concave surface, under a coating which seems intermediate between the upper and lower faces of the leaves, and thus represents its thickness diminished by compression.

The figure of the specimen seems to show the base of the leaf as decurrent on one side. But the branch is broken, and presents the face opposite to the point of attachment, the apparent decurring base being merely the turning of the leaf to the point of attachment behind, and its laceration from the broken stem. Fig. 2, represents the base of the leaves when detached from the stem, and flattened by compression. It is irregularly, deeply undulate-laciniate, with the base of the laciniae inflated, and the intervals corresponding with thick fascicles of nerves, dilated above. Fig. 2, shows the scar of a leaf upon a larger stem; its form and width has no correspondent in any of those figured by Grand'Eury in his *Flore Carbonifère* for stems of *Cordaites*. This author, however, seems to have seen

*The numbers of the plates are not definitive. They are indicated merely for reference to a few copies of the plates furnished, before lettering, to the Proceedings of the American Philosophical Society of Philadelphia out of the edition in preparation for publication in the volume entitled "Report of Progress of the Second Geological Survey of Pennsylvania; Fossil Flora, &c."

leaves like the one described, for he says in a note on a sub-species of *C. borassifolius*, under the sub-specific name of *crassifolius*, loc. cit., p. 216. "I do not know as yet if I can refer to the same type some more consistent thicker leaves of which one of the faces is anguloso-striate by stronger and alternate thinner veins, but of which the other is finely and equally striate." This remark describes the nervation of our species. I should, therefore, have preserved Grand'Eury's name, if the characters of these leaves, especially the mode of attachment, had not been so far different from that of the following section, and especially if the French author had given a description instead of a remark.

Habitat. Cannelton, Beaver County, Pennsylvania, I. F. Mansfield.

CORDAITES CRASSUS, sp. nov.

Næggerathia crassa? Gœpp. Foss. fl. der Ueberganzsgebirges, p. 220, Pl. XL.

The specimens appear rather to represent a large stem of the *Næggerathia* or of *Cordiates* than leaves. Fragments of the same character are found in the coal measures of Pennsylvania. Years ago I sent to Prof. Brongniart, among other specimens, a leaf or stem similar to that described by Gœppert, but with narrower striæ. Its reference was not mentioned by that celebrated author. These fragments vary in thickness, from two to five millimeters, are coarsely but equally striate, resembling flattened stems of *Calamites*, without articulation, and with thinner striæ-like fascicles of nerves inflated at some places, or buried into a thick epidermis.

[GRANDIFOLIÆ.] CORDAITES GRANDIFOLIUS, sp. nov.

Pl. XLVIII, fig. 1, 2, 2a.

Leaves large, of a thick texture, gradually and rapidly enlarging upwards and fan-like, from a narrow, semi-lunar base, thirty centimeters long or more, round-truncate or rounded and undulately lobed and split at the top; nervation double; primary nerves obtuse, three to four in one millimeter, dichotomous or splitting, inflated toward the base, with one often indistinct intermediate vein, becoming more marked near the base.

Of this species I have not seen any stems, and all the leaves which I had for examination have the same truncate narrow base, one of them being cut at the point of attachment in the semi-lunar form of the leaves of *Cordaites*. Among the fine specimens sent by Mr. R. D. Lacoe, of Pittston, most of which are too large for illustration in our plates, the outspreading upwards is marked in different degrees. One of the leaves, for example, is thirty-eight centimeters long, gradually enlarging to the rounded top, where it is sixteen centimeters wide, undulate and split in short laciniae, like fig. 1.

Another leaf with the base six millimeters broad, truncate, but concave as to a point of attachment, is thirty-two centimeters long, and fifteen centimeters broad at the top or there nearly half as broad as long.

The only relation I find to this species is with *Næggerathia obliqua* and

N. Beinertiana Goepp., Gatt. liv. 5-6, p. 108, Pl. XII, fig. 2 and 3, representing much smaller leaves whose description is insufficient. Of the first, comparing it to *N. foliosa*, the author says that the nerves are dichotomous, and more distinct; of the other that they are very close (*creberrimi*), and dichotomous. The first is from the Devonian (grauwacken), the other from the Carboniferous. As far as seen from the figure and the descriptions, the characters of both do not agree with those of this species. Of the first, Schimper supposes that it may be a leaflet of a *Macropterigium*; of the second he says nothing. *N. Beinertiana*, described also by Geinitz, is said to have veins of equal thickness, wrinkled across, two characters at variance with the nervation of these leaves, where besides the inequality of the nerves, the cross wrinkles are less marked than in any other species of this genus, indeed undistinguishable even with a strong glass.

Habitat. Pittston; intra-conglomerate measures, R. D. Lacoe.

[COMMUNES.]

This section might be subdivided into two, one for the species with large leaves, more generally found in the middle coal measures; the other for the narrow leaved species, which appear related to those described by Grand'Eury, under the name of *Poa-cordaites*. I cannot, however, find, either in the nervations, or in the basilar form of the point of attachment of the leaves, any persistent characters which could enable me to distinctly separate them.

CORDAITES BORASSIFOLIUS Ung.

Pl. XLVII, fig. 3, 3a, 3b.

Leaves generally large from five to eight millimeters broad in the middle, where they appear the widest, gradually and slightly narrowing upward and downward, sublinear, obtuse or truncate, and generally more or less deeply split at the top, slightly contracted at the semi-lunar somewhat inflated base. Nervation indistinct to the naked eyes, close, five to seven primary nerves in one millimeter, and generally one intermediate thin veinlet, surface marked by cross wrinkles, more distinct than in the former species.

As figured by Corda, who has exactly marked the characters of nervation, and of the areolation, the leaves are all obtuse and shorter than I have generally found them. The branch which the German author has figured, however, is a young one; the leaves are merely those of the tops of the branches. I have seen in Kentucky, near Amanda furnace, a bed of clay composed mostly of remains of this species, where amongst an immense number of fragments, I found also some large top leaves five to six centimeters broad, some very obtuse, half round, some also split into laciniae in the middle, others narrowed at the top, like that of our figure.

The one figured here is cut in two, the middle part being left out for want of space. It measures in its whole, forty-five centimeters in length, and six centimeters width, in the middle; the lines 3^a and 3^d mark the diameter of the leaf.

These leaves are found in most of the beds of our Carboniferous measures from the Millstone Grit to the Pittsburgh coal, where they are abundant. Not rare at Cannelton.

CORDAITES COMMUNIS, sp. nov.

Leaves of various size, generally smaller than those of the former species, more evidently and generally attenuated to the base; the largest leaf seen of this species is twenty-two centimeters long, and thirty-seven millimeters wide at or near the top where it is broken; fifteen millimeters broad just above the point of attachment, with border generally recurved. The upper surface is covered with a thick epidermis with distinct cross wrinkles. Primary nerves about three in two millimeters, obtuse and more obscure at the upper surface, distinct in the lower, with two to four intermediate veins. The nervation of these leaves is sufficient to separate them from the former species.

One of the specimens represents a branch with leaves attached to it, and semilunar scars of those which have been destroyed. It bears also an unfolding branch, about in the same position as the one figured Pl. XLIX, fig. 2, but with shorter leaves, two centimeters long, more closely imbricated and more enlarged at the base, where they measure five to six millimeters, and small cones (one only is distinct) with imbricated scales exactly like *Cordianthus gemmifer*, of Grand'Eury, as figured Pl. XXV, for his illustration of the Cordaites. It is not possible to see the mode of attachment of the cone.

Besides the character of the leaves the species differs from the former and from any of those described here by the thick bark covering its stem.

It is nearly one millimeter thick, though the stems are flattened by compression.

Habitat, Clinton, Missouri; found and communicated by Dr. J. H. Britts.

CORDAITES DIVERSIFOLIUS, sp. nov.

Pl. XLVIII, fig. 3, 3a.

Leaves narrow, linear, half embracing the stem at the point of attachment, twelve to fifteen millimeters broad, curved backward, except those of the top, which are closely imbricated, and in tuft. Surface distinctly marked by the nervation so that the primary nerves may be counted without glass. These are generally equal, obtuse, three to four in one millimeter, with very thin scarcely perceptible intermediate vinelets.

The specimen figured and mentioned above as the first found in this country with leaves attached to the stems, is from the Salem Vein, near Pottsville. The point of attachment is figured too large, the base being obscured or somewhat covered by fragments of imbricated leaves. I have from this species separate leaves from Clinton, Missouri, one of which measures at the point of attachment seven millimeters, and is enlarged above it to eleven millimeters.

C. angustifolius, Lsqx. Ills. Rept., II, p. 413 (1866).* Name preoccupied by Dawson in Canadian Naturalist, 1861, p. 10.

It farther and gradually increases in width to seventeen millimeters at the broken end, eleven centimeters from the base. Other leaves from the same locality are exactly linear, seventeen millimeters in diameter, while others still, fifteen millimeters above the point of attachment, gradually diminish in width upwards to fifteen millimeters. I remark their dimensions to show the variety of size of leaves of this genus, not merely in comparison with each other but in different parts of their length.

I refer to this species leaves found in large numbers at the same locality as the specimen figured, some of which are flat and linear, others with borders curved inside or half cylindrical, others still true cylinders, not larger than a goose-quill, seemingly coming out of a pedicel or stem, as they are often found in bundles and enlarging upwards in proportion as the borders become more and more open and flattened. The nervation is of the same type, the epidermis thick; they represent in their cross sections an oval line, like figure 3 of Grand'Eury, Pl. XVIII.

Habitat. Upper coal measures of Pennsylvania, Lower coal measures of Missouri; middle and lower coal of Illinois, where it abounds, at Colchester especially, St. John and Du Quoin.

CORDAITES MANSFIELDI, sp. nov.

Pl. XLIX, fig. 1, 1b, 2. Pl. XLVII, fig. 4, 4b.

Stem covered with a thin bark of polished coal, marked by numerous scars of the convex base of leaves, either imbricated or more or less distant, disposed in spiral. Leaves long, erect, nearly exactly linear, gradually diminishing toward the top to an obtuse point, averaging fifteen millimeters in diameter, distinctly and distantly nerved; primary nerves fifteen to eighteen in one centimeter, with two to four intermediate veins; surface rugose across as in the former species; branches oblique with imbricated leaves of proportionate size. Flowers composed of four sepaloid involucre, borne upon simple flexuous pedicels, to which they are attached by short peduncles.

As seen from the splendid specimen figured here and from a number of others quite as remarkably well preserved, the species is characterized by its long, erect, linear leaves, whose surface is marked by a strong nervation (1^a enlarged double, 1^b enlarged four times) rounded and narrowed to the point of attachment, reduced to half the diameter of the leaves, perfectly entire and obtusely pointed. The stems are covered with a thin coating of coaly, shining bark, where the scars are distinctly marked, but no more so than upon the subcortical surface. The branches apparently form the axils of the leaves, one of which is seen, fig. 2, bears leaves proportionate to their length and their age, imbricated, linear-lanceolate, obtusely pointed, with a nervation of the same character, reduced, of course, to proportionate dimensions by the size of the leaves. Another specimen bears a branch two to three centimeters thick, diverging in the same degree as that of the figure, twelve centimeters long, with leaves proportionate in size, the largest already fifteen centimeters long, all imbricated,

linear-lanceolate, with the borders incurved, especially towards the top, which thus appear acuminate. The nervation has equally the character of the large leaves, the primary veins being one half to three-fourths of a millimeter distant, with two or three intermediate distinct vinelets.

Under the name of *Cordianthus simplex*, I refer the stem bearing flowers, Pl. XLVII, fig. 4, 4^a, to this species especially because the specimens were found in the same shale and in proximity to those bearing leaves, though not in connection with them. Of these stems one is entirely naked, without leaves or flowers; the other figured here shows some difference in its slightly thicker coaly surface and in the absence of distinct leaf scars. These, however, may have been obliterated by longer process of decomposition; for the racemes of flowers are flattened by compression and irregularly flexuous, with their vascular filaments distinct, as if the branches had been in an advanced state of maceration. The flowers, which appear to be male flowers and borne upon a short peduncle, are mostly turned downward and are composed, as seen fig. 1^a, of three or four involucrel, thick, lanceolate, abruptly pointed sepals. The point of attachment of the elongated narrow racemes is round, inflated in the lower part, as seen fig. 4^b. Their position in regard to the leaves is not possibly seen.

Comparing these fructifications to those which have been figured by Grand'Eury, there is a marked difference in this, that all the flowers figured by this author either sterile or fertile are sessile upon the branchlets. It is the same with those figured by Dawson under the name of *Trigonocarpum racemosum* in his Devonian Plants, Quat. Jour. Geol. Soc. vol. XVIII, Pl. XVI, fig. 47, which are referable to *Cordianthus baccifer* of Grand'Eury; those also of Weiss, Foss. flora, p. 195, fig. 1, representing *Cordianthus gemmifer*. A point of likeness only is found for the form of the flowers attached to a short pedicel and the thick raceme in Sternb. Fl. der Vorw., Pl. XXVI, fig. 2. This figure, though described without reference as *plantula debilis*, p. 33, evidently represents flowering branches of *Cordaïtes*.

Habitat. Canneton. I. F. Mansfield.

CORDAITES GRACILIS, sp. nov.

Pl. XLVIII, fig. 4-4^b.

Stem slender, with a rugose somewhat thick bark; leaves sessile by a narrowed base, open or curved backward, distant, gradually enlarged from the base upwards, sublinear, obtusely truncate at the top; nervation indistinct in the upper corticated surface, which is somewhat rough, primary nerves variable in distance from one millimeter apart to three or four in two millimeters, with one or two, even four, intermediate, very thin veins.

Closely allied to the former by its distinct and distant nervation, it is, however, far distant by the form, the size, the position of its leaves, and its thick, rough bark. The part of stem preserved is seventeen centimeters long, seven millimeters wide at its base, four millimeters at its top, flat-

tened by compression. The leaves are either at right angles to the stem or curved backwards from their point of attachment, nine centimeters long, gradually enlarging from the base, five millimeters, to the top one centimeter wide, where they are rounded and obliquely truncate, the point slightly curved inside or concave as marked in the figure. Fig. 4^b shows the point of attachment of the leaves observed upon another specimen.

Habitat. Morris, Illinois, lowest bed of coal above the Millstone Grit; found by Mr. S. S. Strong. One specimen with broken leaves, but distinct scars, is from Cannelton, by Mr. I. F. Mansfield.

[COSTATE.]

Stems or branches irregularly costate by the prolongation of the base of the protuberant leaf scars, whose upper surface is covered by a smooth shining coating of coaly bark.

CORDAITES COSTATUS, sp. nov.

Pl. LI, figs. 1-4.

Stem irregularly costate, leaves narrow, nearly linear, five millimeters broad above the point of attachment, gradually enlarged to nearly one centimeter at the point where they are broken ten centimeters from the base; nervation distinct; primary nerves unequal in distance, three to five in two millimeters, with three or four intermediate vinelets especially distinct on the under surface of the leaves; surface cross wrinkled; flowers narrowly ovate, composed of appressed, imbricated, narrow, linear-lanceolate, acuminate scales, sessile, upon long decurring cylindrical racemes.

The branch, one and a half centimeters broad, bears as basilar support of the leaves, tumescent, reniform scars, fig. 2, narrowed at the base into a linear inflated support, which, after the disruption of the leaves, form, when persistent, narrow, carinate, alternate ridges, becoming sharply keeled and distinct in the old stem, as seen in fig. 3; or when destroyed by maceration, leave a cavity of the same size with elevated borders. The leaves are in an acute angle of divergence from the stem, somewhat loosely imbricated in spiral. Sometimes as seen in *a*, they appear decurrent by a casual flexion of the lower part to the stem.

The flower bearing peduncles are cylindrical, apparently of hard texture, slightly inflated, or like articulate at the point of attachment of the flowers which are sessile or with a very short pedicel. The form of the flowers is very different from that of the ones described from specimens of *C. Mansfieldi* and of *C. communis*.

Habitat. We have three specimens of this fine species found by Mr. I. F. Mansfield, at Cannelton.

[SERPENTES.]

Stems narrow, flexuous or serpentine, abruptly terminating into a large, flat leaf.

CORDAITES SERPENS, sp. nov.

Pl. L, fig. 1-4

Stems narrow, fifteen to twenty-five centimeters thick when compressed, covered with a thin coaly opaque layer of bark, marked by somewhat distant semi-lunar scars of leaves. Leaves at right angles to the stem, sub-linear or slightly enlarging upwards, eight to ten millimeters broad, rounded in narrowing to the point of attachment, distinctly veined. Primary nerves nearly at equal distance, effaced towards the borders, three or four in three millimeters, with three to five, more generally three, very thin intermediate secondary veins. Top of stems abruptly terminating into a broad, flat leaf, as broad as the stem, covered with double coating of coaly matter, the upper one somewhat thick, destroyed near the point of conjunction with the stem, but distinctly nerved like the lower one, thick also, whose nervation is of the same character as that of the leaves, the primary veins only a little closer, showing in relief on the under surface, thin, obtusely keeled careens.

The specimens figured elucidate the species as far as it has been possible to see it. In fig. 1, representing the only specimen with leaves, those coming out of the stem, near its point of disruption, are narrower and divided in flexuous, linear-lanceolate, pointed laciniae, deeply marked by fascicles of veins. In fig. 2, the abrupt termination of the stem is clearly marked in conjunction with the terminal leaf. Fig. 3 has the upper part, the bark, destroyed by maceration. The stem is preserved in its cylindrical state, not compressed, and shows the transverse ribs of *Artisia* perfectly distinct, obtuse. The depression in fig. 3, which seems upon the figure as a corrodation or a destruction of the stem by maceration, is an abrupt termination as in fig. 2; for the coating of coaly matter, nerved like that upon the terminal leaf, covers the declivity to the border of the cylinder.

Professor Dawson has a branch of *Sternbergia* or *Artisia** pith, which he says is probably of a *Dadoxylon*, which represents this abrupt termination in a most remarkable manner, the pith being one and a half centimeter thick, terminating in a cone of six or seven gradually smaller rings, the last one only half a centimeter in diameter. (Geol. Survey of Canada, 1871, Pl. III, fig. 28). He supposes also referable to *Dadoxylon* another fragment of the same character, bearing on one side a piece of thick bark as we see it bordering the stem of fig. 3. It is represented in Canadian Naturalist, May 1861, as *Dadoxylon Ouangondianum*, and considered by the author as a conifer.

Fig. 4, of our plate, reduced in size, represents a long stem of this species, flexuous, narrower per places, especially in the middle, somewhat inflated at both extremities; it is fifty centimeters long, varying in width from twelve to twenty-four millimeters, covered with close, tumescent scars of leaves, which are obtusely rhomboidal, six millimeters in hori-

*The names are synonymous, referring to those cross ribbed branches which Corda considered as stems of *Lomatophloios*.

zontal direction, four millimeters in the vertical one, also covered with a thin layer of opaque coaly bark.

This species seems to represent a floating rather than a creeping plant, for no traces of appendages like radicles or their scars can be observed upon any of the specimens. The prolongation of the stem into a broad, flat, thick leaf, seems to indicate that kind of growth in water, as it appears to serve as a support to the plants on the surface of the water.

The cylindrical part of fig. 3, deprived of its thick bark, which is left on both borders, evidently shows, not merely the relation, but the identification of *Cordaïtes* with *Artisia*, an identification which is still more closely seen upon a number of other larger stems of *Cordaïtes*, one of them figured Pl. LII, fig. 2. It shows a double layer of bark which, whenever it is destroyed, distinctly exposes the horizontal ribs of *Artisia*. This fragment appears articulate, and marked on one side of the articulation by a large, protuberant scar of a branch, while on the other side it shows the semi-lunar scar of a leaf. No trace of articulation has been until now remarked upon stems of this kind, at least none is mentioned in the work of Grand'Eury, who has so remarkably illustrated this genus. The specimen bears, just near the branch-scar, a bundle of narrow leaves of *Tæniophyllum contextum*. Pl. LIII, fig. 2,—but the bundle does not touch by its base the scar of the branch, nor does it appear to be in connection with it, and as the specimen, a large piece of shale, is covered with bundles of the same leaves, I do not consider them as related to this stem. Another specimen, a branch twenty-two centimeters long, three and a half centimeters broad, convex or half flattened, whose surface is partly covered with the coaly layer and the distinct semi-lunar scars of leaves, six millimeters broad, shows, where deprived of its bark, or upon more than the two-thirds of its surface, the distinctly marked cross ribs of *Artisia*. These ribs are variable in width from one to two millimeters, parallel, sometimes slightly undulating in their borders, but traversing right across the tumescent obtuse scars of the leaves, without any deviations in their direction, nor any kind of branching which could indicate the passage of vessels of leaves into the subcortical cylinder. On one of the borders of the branch, the bark either flattened, or cut lengthwise like that of Pl. L, fig. 3, is half a centimeter thick. The surface coal layer, however, is not more than one-fourth or scarcely half a millimeter thick. That therefore the *Artisia*, or at least most of the stems described under this name, are the woody cylinder of *Cordaïtes* is established beyond a doubt by these specimens.

I cannot assert from the examination of my specimens that species of *Artisia* may not be referable to *Dadoxylon* representing *Conifers*. But I have not seen as yet any branches of *Artisia* which might be separated from the *Cordaïtes*; and if *Artisia* species are found with the characters of the *Conifers*, the *Artisia* of *Cordaïtes*, or those described by the authors and referred to plants of different genera, should have the same characters. This has not been positively established.

Grand'Eury refers *Dadoxylon* and its *Artisia* stem to *Cordaïtes*. Corda

has, the first and most carefully, analyzed and described *Artisia* as the pith cylinder of *Lepidophloios*, a genus generally considered in intimate relation to *Lepidodendron* or *Lycopodiaceæ* by Grand'Eury, Goldenberg, Shimper and others; therefore, the reference of *Artisia* to any kind of *Conifers* is as yet, it seems, unauthorized. I have treated the subject with some more details in considering the general characters of the Carboniferous flora.

[FLOWERS AND FRUITS OF CORDAITES.]

Under the name of *Cordianthus*, Grand'Eury has considered as evidently referable to *Cordaites*, the flowering branches known formerly under the name of *Antholithes*. The racemes of flowers described here with *Cordaites mansfieldi*, *C. communis*, and *C. costatus*, evidently prove this relation. For, if they are more slender and less developed than those which have been found separated from the stem, as the *Antholithes*, the characters of these organs are evidently identical. They represent either male flowers, buds covered with imbricated scales, containing merely a powder which may be the pollen; or fertile flowers in small oval or round ovules. Of these we have only the following species referable to male flowers:

CORDIANTHUS GEMMIFER, Gr. d'H.

Pl. XLVII, figs. 5 and 6.

Buds sessile, upon a thick, simple raceme, broadly oval; scales imbricated, oval, obtusely pointed.

This species, represented by fig. 5, corresponds to that of fig. 4, Pl. XXVI, of Grand'Eury. The second with longer oval lanceolate, more acute scales of a narrower cone, as represented by fig. 6, corresponds to fig. 6 of the same plate of Grand'Eury.

Of the fertile flowers, *Cordianthus baccifer*, I have not found any. A branch described and figured in the Geological Report of Illinois, IV, p. 427, Pl. XI, fig. 6, under the name of *Schultzia bracteata*, Lesqx., bears on one side of the raceme cones identical by their characters to *Cordianthus gemmifer*, while it has on the other a closed bud or a round tubercle, borne upon a short, inflated pedicel, which appears to represent the round tubercles of *Cordianthus baccifer*. This, therefore, would imply the monoicity of these flowers, while all the specimens published by Grand'Eury and other authors, represent only racemes with either gemmifer or baccifer flowers, and therefore indicate the inflorescence as diœcious. My specimens are not good and distinct enough to authorize a definite conclusion, as the bacciform bud may represent merely the top of a gemmiform one,* whose basilar scales have been destroyed and detached by maceration. The remaining top, however, is exactly globular. By detaching the scales of the gemmifer cones, I found under them a transparent, yellowish membrane, formed of elongated, equilateral, small meshes or areolæ, inclosing or sup-

*Grand'Eury remarks with reason, that these flowers are generally so much altered by decomposition, that it is rarely possible to fix the sex which they represent.

porting small granules of opaque brown matter. These granules, scarcely the hundredth part of a millimeter in diameter, are of a roundish, irregular polygonal form, agglomerated and separating with difficulty. Their size and irregularity of form prevent us from considering them as spores; they look rather like grains of pollen.

Most of the authors of works on vegetable paleontology have figured and described as *Antholithes*, under different specific names, some of these organs. Already in 1854, Professor Newberry has a representation in the Annals of Science of Cleveland, of three branches, reproduced in the first volume of the Paleontology of the Geological Survey of Ohio. The one Pl. XLI, fig. 1, of this last work, *Antholithes* Pitcairniæ, Lld. and Hutt, is like our fig. 6; the spikelets, however, being naked, or without the linear bracts generally found supporting the flowers of *Cordaïtes*. As my specimens show part of the flowers without these bracts, this difference is probably due to the degree of maceration to which the plants have been subjected. Fig. 2 is *baccifer*, the ovules being not only sustained by a leafy bractlet, but half inclosed at their base into an involucre. Nutlets of the same kind and form, but much larger, are represented attached to thick branches in fig. 4, as *Cardiocarpon*, while fig. 3, under the name of *Antholithes* *priscus*, Newby, represents a *Cardianthus* *gemmifer*, whose upper scales are mixed with leaves apparently originating from under the scales.

All the forms described by the European authors are represented in the splendid plates of Grand'Eury, who has separated, as flowers of *Poa Cordaïtes* the slender, flower bearing racemes which I have described with *Cordaïtes* *mansfieldi* and *C. costatus*.

Of the fruits and nuts referable hypothetically to *Cordaïtes* the number is considerable. But except the nutlets figured by Newberry, Dawson and Grand'Eury, no larger fruit has been found positively attached to stems or branches of *Cordaïtes*, nor indeed of any other coal plants. I have figured, Pl. LIV, the fruits most commonly found at Cannelton in shale bearing *Cordaïtes* remains. They are described with the other kinds of fruits of the coal. These may be compared only to two species of Grand'Eury as remarked above.

Of all the others referred as *Cordaïcarpus*, *Cardiocarpus*, *Carpolithes*, to *Cordaïtes* or *Næggerathia*, there are scarcely any at Cannelton. Geinitz refers *Rhabdocarpus* species to *Næggerathia*. To *Cordaïtes* *principalis* he refers *Carpolithes* *Cordai*, as yet unknown in our coal measures, while the common fruits of Cannelton, figs. 8 to 11, are most like if not identical to *Cardiocarpon* *Gutbieri*, which Geinitz does not refer to *Cordaïtes*; while Grand'Eury names the same species *Cordaïcarpus* *Gutbieri* among the fruits of *Cordaïtes*. It has a distant likeness to our fig. 8, and therefore all these fruits, fig. 6 to 11, might be hypothetically considered fruits of *Cordaïtes*, as by transition they seem to represent, either the same, or two closely allied species. It is the only trace of light we have on the subject. The two fruits, fig. 7, are of different type. They are attached to a broken pedicel, and were found also with the *Cordaïtes* of Cannelton. They are, like the others, described with the fruits of the Carboniferous measures.

CORDAISTROBUS, Lesqx.

Strobile conical, tapering to a point, covered by transversely rhomboidal scars, placed in spiral, bearing narrow linear leaves, with the characters, form and nervation of leaves of *Cordaïtes*.

The plant from which this genus is established might have been described perhaps as *Cycadoidea* or *Mantellia*, a genus established for the description of stems of *Cycas*, mostly globular, or conical obtuse, or nest form, all referable to a more recent formation, the Permian. As the leaves are of a different character, as also the reference of this cone to *Cycadæ* is merely indicated and not positively ascertained, I think advisable and more rational to describe it under this new genus, which indicates its relation.

CORDAISTROBUS GRAND'EURYI, sp. nov.

Pl. LIII, fig. 3.

Cone cylindrical from the base to the middle, narrowed upwards and acuminate, borne upon a somewhat thick pedicel or axis equally striate in the length; scars transversely rhomboidal, inflated in the lower part, bearing at the top another smaller rhomboidal scar point of attachment of linear leaves, marked by parallel distinct nerves.

The leaves are short, mostly broken near the point, one only preserved in its whole on one side; of the other, four are left, close to each other, all evidently attached to the rhomboidal scars of the cone. The scars show the spiral disposition of the leaves. The nervation of the leaves seen in 3a, is exactly of the *Cordaïtes* character. The primary nerves are close, especially toward the borders, and separated by one or two intermediate veins. The axis of the cone, as far as it is seen upon the specimen, is covered by a comparatively thick coally bark more than half a millimeter thick. It is deeply and regularly striate, the striæ being also obscurely seen along the middle of the cone, even to its point, by compression of the scars, as represented upon the figure.

I consider this cone as proving more than any other of the organs described, the relation of *Cordaïtes* to *Cycadæ*. By the leaves it is a true *Cordaïtes*; by the scars and their disposition it represents a small stem of *Cycas*. It is, however, difficult to explain its true nature. It does not look like a fruiting cone, and all that is known until now of the stems of *Cordaïtes* is without relation to this branch. Dr. Newberry has represented, loc. cit., as *Antholithes priscus*, a branch of *Cordianthus*, bearing small recurved gemmifer cones, to which are appended short leaves which seem as originating from under the scales. This is the only organism which might perhaps explain the nature of this strobile by supposing a kind of viviparous vegetation produced directly from the flowering cones of *Cordaïtes*. Though it may be, that its relation, as remarked above, is clearly marked as a point of connection between *Cordaïtes* and *Cycadæ*.

Habitat. Cannelton. Mr. I. F. Mansfield.

DICRANOPHYLLUM,? Grand'Eury.

The author has described under this name linear narrow leaves of various length, twice forking at the top, coriaceous, marked with a few thick

nerves and intermediate nervilles more or less immersed into the epidermis. These leaves are inserted around small branches upon tumescent small bolsters, whose disposition is in regular spiral, with a rhomboidal section recalling those of the *Lepidodendron*, but formed by the fleshy base of laterally decurring leaves like those of some *Conifers*. He adds that the leaves of one of his species, *D. Gallicum*, do not seem to have been caducous, some remains of them are generally seen even upon the oldest branches, where they have not left any distinct scars. The coaly envelope of the branches is thick, the foliaceous bolsters are soon effaced upon it, as if the bark had increased in thickness in contact with a ligneous increasing body, as in the dicotyledonous.

The description of the stems and of the rhomboidal scars placed in spiral and left upon the branches, and also the fig. 3, of a branch, in Pl. XIV of his flora, corresponds in part with the characters of the cone or branch described above. But the leaves of *Dicranophyllum* are of a different character from that of the *Cordaites*, and, therefore, the author has separated this genus from the order of the *Cordaites*.

The organism, which from its leaves I consider as a *Dicranophyllum*, differs in many points of the above description, but some of its characters are so clearly corresponding that I do not find reason to separate them. It will be seen, however, that from our specimens, the relation of the species is truly to the *Cordaites*, and that the genus cannot be separated from this order.

DICRANOPHYLLUM DIMORPHUM, sp. nov.

Pl. LIV, fig. 1-2.

Stems or branches small, the largest seen not quite two centimeters wide, when flattened; apparently articulated at the point of divergence of the branches and there abruptly narrowed, covered with a coaly bark about half a millimeter thick; stem leaves in oblique or right angle to the branches, narrow, three millimeters broad near the inflated smooth base at the point of attachment, linear or slightly diminishing toward the upper part, where they are forking once or twice, covered with a thick epidermis wherein the veins are buried and obtuse; nerves distinct under the epidermis, four or five primary ones near the base, unequally distant, intermediate ones indistinct or not perceivable with the glass. The stem, fig. 2, is marked upon the bark by round, small, inflated bolsters, corresponding under it to small cavities of the same form and size, very irregular in their distribution, sometimes three placed directly in line, sometimes scattered. I do not consider them as scars of leaves; they are probably the remains of small mollusks like those which so profusely inhabit the substance of the leaves of *Cordaites*. The top of the same fig. 2 which is not figured, bears a reniform scar like those of *Cordaites costatus*, but it is probably that from a top leaf like those of fig. 1.

The stem, fig. 1, seems like articulate by a depression across its whole diameter at the point of attachment of the branch 1a. The top of this

branch terminates abruptly in an obtuse point, to which is attached a somewhat thick leaf of *Cordaites* character, or with parallel nervation. The top of the main stem bears a tuft of three leaves of the same character as that of *a*, flat, linear, one centimeter broad. The two on the left side are somewhat thick and the nervation immersed in the epidermis; that on the right side in *b* is decorticated or represented by the impression of its lower surface, with primary nerves distinct to the eye, three in one millimeter, with two or three distinct intermediate ones. The other leaves attached along the stem are those of *Dicranophyllum*, with nervation more or less obsolete by the thick epidermis, and are of the same character as those of fig. 2. We have here, therefore, in the abrupt termination of the branch *a*, and the large leaves at the top of the main branch, the evident characters of *Cordaites*, while the stem leaves are as evidently of *Dicranophyllum*. One of our specimens, fig. 3, represents a small fruit, oval and similar in form to the bulbilles, which Grand'Eury has seen in the axils of the leaves of *Dicranophyllum*, Pl. XXX, fig. 3, of his flora, but somewhat larger, with flattened borders, and of a thick texture; at least its surface is covered by a pellicle of coal as thick as that upon leaves of *Dicranophyllum*. From under it, or as in its axil, comes a *Dicranophyllum* leaf four millimeters broad, soon splitting twice, and separating in three narrow branches, hamulose in their curve, and dividing again in filiform laciniae at their extremities. The character of nervation, four primary distinct nerves in one of the laciniae, as seen in *a*, where the thick epidermis is destroyed, are exactly the same as in the leaves of fig. 2. Hence I believe that we have here positive evidence of the relation of these organs to the genus established as *Dicranophyllum* by the celebrated French author and of that of this genus to the order or family of the *Cordaites*.

[TÆNIOPHYLLÆ.] TÆNIOPHYLLUM, Lesqx.

Stems large, leaves crowded, flat, thick, exactly linear, decurring at the base, surface smooth, opaque or shining.

The plants referred to this division resemble those of the narrow-leaved *Cordaites* by the size of their leaves only. These are still narrower, more exactly linear, and their surface is not striate or marked by nerves, neither when corticated nor when deprived of their coaly epidermis. Seen with a strong glass, their surface appears lined lengthwise and crosswise by a very thin areolation composed of appressed square meshes resembling those of the finest tissue. The leaves are, as far as can be seen, very long. I have not been able to find one in its entire length in any of the specimens examined. Their point of attachment still more than their smooth surface separates them from *Cordaites*, this point being marked by a linear narrow scar, rounded and slightly inflated at its lower end, generally pointed or acuminate upwards. The species referred to this group represents evidently a different generic division if not a separate family.

TÆNIOPHYLLUM DEFLEXUM, sp. nov.

Pl. LIV, fig. 4.

Stem or branch narrow, leaves closely imbricated, apparently decurrent, their base being covered by fragments of broken leaves decurving to and expanding in right angle from the stem, surface smooth.

The part of a branch figured here is entirely covered with broken fragments of detached leaves and its surface is nowhere exposed. The leaves deflexed along the borders in right angle to the stem, seemingly from above the decurrent base, all flattened and parallel, their border generally contiguous, measure one centimeter in width and thirty-seven centimeters in length to the point where the specimen is broken. The coaly epidermis is on the surface very thin and fragmentary, or spread here and there like powder by decomposition; but the leaves taken altogether appear of a somewhat thick consistence. I have of this species only one specimen, a large piece of shale, of which a fragment only is figured. Seen with a very strong glass, the veins of the surface may be approximately counted at twenty in one millimeter space; the cross wrinkles are also of the same size.

From the flat position of the leaves, all parallel and in the same direction, they appear as expanded originally upon the surface of the water. The narrowness of the stem also compared with the numerous and long leaves seem to indicate a floating plant. The cross section of the leaves show both surfaces separated by a thin layer of shale or clay, as if the leaves had been in their original state, somewhat inflated or tubulose.

Habitat. Cannelton. Mr. I. F. Mansfield.

TÆNIOPHYLLUM DECURRENS, sp. nov.

Pl. LI, fig. 4. Pl. LII, fig. 1.

Stem large; leaves decurring, narrower than in the former species, obtuse, sublinear or very slightly enlarged from the base upwards, long and thick; surface same as the former, more opaque.

Both the figures represent the leaves decurring upon the stem by an elongated base, but in Pl. LI, the leaves preserve in their length, as far at least as it can be seen, the same diameter all along their decurring base, while Pl. LII, they are gradually narrowed downward from their point of attachment, forming, as appressed upon another or against each other, narrow basilar prominent ridges. The leaves also of fig. LI, are slightly broader and more distinctly enlarged upwards. As the trunk of this specimen is not decorticated, I could not compare the point of attachment; and the characters of texture, facies and size of the leaves being the same, I consider them a variable form of a same species, perhaps even the variation is caused by a difference of compression and maceration of fragments of a same tree. The leaves average five to seven millimeters in width, crowded, forming by their imbricating and decurring long base a thick coating of coaly bark, which, when destroyed, leaves the surface smooth

or irregularly lined and wrinkled, marked by numerous leaf scars, some of them distinctly seen, some others destroyed or obscure, so that their relative position is not definitively recognizable. They are placed in spiral, but their place is not always indicated by the scars. These scars generally obtuse and inflated at the base, where they measure one millimeter in diameter only, are gradually effaced and narrowed upwards, and therefore their character is far different from that of the *Cordaites* scars of leaves. The bark of the stem also is much thicker, not merely a thin smooth pellicle of coal, but a coating of shaly carbonaceous matter one millimeter thick or more. The divergence of the leaves from the stem is at a far less degree than in the former species; the thickness of the leaves and their surface tissue are the same.

Same *Habitat* as the former. Mr. I. F. Mansfield

TÆNIOPHYLLUM CONTEXTUM, sp. nov.

Pl. LIII, fig. 2, 2a.

Leaves narrow, linear, two millimeters broad, apparently very long, obtuse, twisted or interlaced together in tufts, and erect, diverging and curved in the upper part, surface opaque.

The tissue of the epidermis is of the same character as in the former species, from which this one differs merely by the narrower leaves more compactly bound together in the lower part. They appear to have been originally fistulose and flattened by compression. Their substance is thick, the epidermis a coaly layer irregularly disrupted in minute elongated granules, as marked in fig. 2a. I have not seen any of these leaves in connection with a stem. Though I do not consider this species as the same as the former, the characters are very similar. By compression and flattening an inflated border is here and there formed along some of the leaves, and by their superposition, it gives to the upper ones the appearance of a middle nerve. In a few cases when the heavy coating of coaly matter is removed, the veins appear in fascicles similar to those of the leaves of *Dicranophyllum*. These leaves are of the same kind as those mentioned on p. , a bundle of which seems connected to an *Artisia* in the description of *Cordaïtes* specimens.

Habitat. Same as the former. Mr. I. F. Mansfield.

DESMIOPHYLLUM, Lesqx.

Leaves narrow, sublinear, gradually enlarged from the base, where they are joined three or four together and coming out from a common point of the stem. Surface irregularly ribbed lengthwise by prominent large bundles of nerves, buried under the epidermis, which is thick, irregularly granulose, by splitting of the coaly surface as in the species of *Tæniophyllum*.

From this coincidence of characters in the surface of the leaves, I was inclined to consider this peculiar branch as referable to the same genus. It, however, greatly differs by the agglomeration at their base of some of

the leaves coming out in bundles from a common point of the stems, which appears irregularly articulate. Some of these leaves seem separate and joined single by a semi-lunar base to the stem. But I have to remark that the points of attachment of the inferior leaves in *a* are not perfectly distinct, and appear rather truncate than semi-lunar and embracing. The point of attachment of the leaves in bundles is, however, distinct. Therefore I am in doubt if the lower leaves may not have been separated from a common point and scattered along the stem, where by compression they have merely the appearance of being joined to it. The round points showing scars of bundles of leaves, are seen all along the stem and at equal distance from each other, even to the very base, and, therefore, the separate distribution of the others along the stem seems anomalous.

If the position of those scattered leaves and the point of attachment is right, as it can be seen upon the stone and as figured, this genus would partake of some of the characters of the leaves of *Cordaïtes*, by their semi-embracing base and the nervation buried into the substance of the leaves but recognized by the striæ of the surface. The degree of relation to the former genus is marked as seen above by the character of the epidermis. The connection of a number of leaves from one and the same point and from an apparent articulation is peculiar and gives to the branch an appearance comparable to that of the rhizomas of some *Equisetaceæ*; the characters of the leaves are, however, totally different from those of rootlets.

DESMIOPHYLLUM GRACILE, sp. nov.

Pl. LIII, fig. 1.

The specific characters are the same as those of the genus.

The figure is an exact representation of the specimen as far as it can be observed. The stem, a little more than one centimeter thick and flattened, seems to have been, if not fistulose, at least, soft and flexible. Its surface has the same appearance as that of the leaves, the epidermis having the same texture, and the bundles of nerves being also indistinctly discernible by the irregular ridges, or vertical, more or less obscure, and always obtuse wrinkles. The leaves appear long; none of them are preserved entire. They are sessile, two or three millimeters broad, only at their point of attachment, two to four together, to a circular scar, and gradually and equally enlarging upwards to about one centimeter at the point where they are broken. To the naked eye the leaves and stems appear smooth, rather shining, but with the glass the surface is seen minutely rugulose.

I do not know of any plant of the coal measures to which this fossil organism could be compared. The disposition of all the leaves of *Cordaïtes* is in spiral order, this species, therefore, can not be placed in the same division.

Habitat. Same as the former. Mr. I. F. Mansfield.

LEPIDOXYLON, Lesqx.

Stems, or branches of large size. The fragment figured is six centimeters broad, rapidly diminishing in its upper part to a conical point;

bark thin, covered with leafy scales; leaves of various size, sub-linear, narrowed or enlarged to the point of attachment, forking or dividing upwards in two or more laciniae; nervation distinct with the glass only; primary nerves parallel, about three in two millimeters, buried in the epidermis, more distinct upon the decorticated face, generally inflated or half round, intermediate veinlets very thin.

LEPIDOXYLON ANOMALUM, Lesqx.

Pl. LIV, fig. 5. Pl. LV, fig. 1-1a.

Schizopteris anomala, Brgt. Veget. Foss. p. 334, Pl. CXXXV.

The character of the species is that of the genus.

The bark is a thin coating of coaly matter covered with sparse, distinct, foliaceous, oblong, lanceolate-pointed or acuminate scales, marked near the base by a short inflation like a midrib.

The lower surface of the stem where this thin bark is destroyed, shows round scars of various sizes from one to two millimeters in diameter, which represent either the base of the scale or that of small leaves. Short, small leaves narrowed to the base are attached upon the stem mixed with the scales. On the borders, the leaves are more enlarged at the base, some of them, however, narrowed; others seemingly broken and compressed upon the stem; others still, enlarged as a mere diverging part of the stem. They vary in diameter from three to ten millimeters, dividing by an anomalous forking with an acute sinus, either from near the base or from above, marked in the length by parallel, equal and equally distant primary nerves, and very thin intermediate veins.

I consider the species as identical with that of Brongniart, described in great detail, loc. cit., especially from the figures of Geinitz, Versteinerungen der Steinkohlen Formation in Sachsen, Pl. XXVI, fig. 2, which shows the divisions of the leaves of this species somewhat broader than those of Brongniart. In our specimens, as figured, the leaves are still broader. I must say, however, that in another specimen in my possession, which is like the top of Pl. LV, the stem, whose scars of scales are marked upon the bark in elevated round points, bears, mixed with these scales, linear leaves as narrow as those figured by Brongniart. Though there might be some doubt of this identity of species between the American and the European plants, they evidently belong to the same group, and are referable to the same genus.

Specimens of *Schizopteris* are very rare. After Brongniart none have been found, or at least described, but that of Geinitz. Brongniart in considering his species admits it as probably referable to Ferns. Geinitz joins it to *Aphlebia*, Presl., *Rocophyllum*, Schp., a genus which as seen from the species described in this flora, is a compound of mixed types, whose affinity is unascertained, and which Schimper considers as representing primary fronds of ferns. From this genus this species is positively removed, not only by its peculiar stem, but by character of its ribbon equally nerved leaves. On the true relation of the plant to any of the present time, I can

say nothing. Like *Cordaïtes* it has some analogy to the *Cycadæ*, the Conifers and the Monocotyledonous, the Glumaceæ. But it is evident from the character of its leaves, some of which are narrowed to the point of attachment, that this species is in relation to the groups of the *Tænophyllum*, as also by its nervation to the *Cordaïtes*.

There is in the stem a peculiar character, which should be remarked. It rather appears to have been soft than of hard texture. The bark is so thin that by erosion some of the scales and young leaves are left attached to the lower surface of the stem as seen in the upper part of Pl. LV, fig. 1. On another side large leaves, especially seen upon my specimens, are decurring at the base along the stem, and seen to join it by a division of its borders, or come to it in a more or less open angle of divergence without any diminution of their width, and without apparent division in their point of union, just as if they were part of the stem. The epidermis of the leaves is also thin, its surface reflects the largest nervation buried in the texture, which then appears obtuse, distant as in figure 2 of Brongniart, but under the epidermis, these primary veins are less discernible, sometimes totally unobservable, the intermediate very thin vinelets covering the whole surface.

Habitat. These remarkable specimens, which if they do not throw light upon the relation of this plant to those of our time, give at least indication of their reference to the family of the *Cordaïtes*, have been found and communicated by Dr. J. H. Britts, from the Clinton coal of Missouri.

The Columella and Stapes in some North American Turtles.

BY SARAH P. MONKS.

(Read before the American Philosophical Society March 1, 1878.)

The columella is a small bone found in most reptiles which extends from the parietal to the pterygoid, and helps to complete the lateral wall of the cranium.*

In *Lacertilia* it is a distinct, slender rod "in close contact with the other cranial bones at its extremities only.

In *Testudinata* on the other hand it is broad, short and scale-like, and closely articulated with other bones.†

It varies considerably in the different species and families, and in some seems to be wanting.

In nearly all turtles there is a strongly marked ridge extending forward from the quadrate to the top of the skull, and another not so distinct from the pterygoid backward to the same point on the top of the skull.

*See Professor Cope "On the Homologies of some of the Cranial Bones of the Reptilia, and on the Systematic Arrangement of the Class."

†Proceedings of Association for the Advancement of Science, 1870, Vol. XIX, pp. 223, 224, and Professor Huxley's Anatomy of Vertebrate Animals, 1872, p. 189.